REMARKS

Reconsideration of the above-identified patent application in view of the amendments above and the remarks following is respectfully requested.

Claims 1-66 are in this case. Claims 30, 32, 41-50, 61, 63 and 66 were withdrawn by the Examiner from consideration as drawn to a non-elected invention. Claims 1 and 7-9 have been rejected under § 102(e). Claims 2-6, 10-29, 33-36, 38-40, 51-60, 64 and 65 have been rejected under § 103(a). Claims 31, 37 and 62 have been objected to. Dependent claims 4, 10, 12, 14, 22, 54 and 57-60 have been canceled. Independent claims 1, 33, 36, 51, 64 and 65 and dependent claims 5, 6, 11, 13, 15, 16, 19, 23, 24, 27, 31, 39 and 62 have been amended. New independent claims 67-76 have been added

The claims before the Examiner are directed toward an optical device and applications thereof. The optical device includes a planar grating, with electrically conducting stripes, that has a space-variant, continuous grating vector. At least a portion of the grating has a local period less than the longest wavelength of light that is to be incident on the grating. Alternatively, the grating is such that a beam of light transformed by the grating includes substantially only a zero-order propagating component. In different embodiments of the device, the grating vector is periodic, the grating passes or reflects laterally uniform polarized incident light with a predetermined laterally varying transmissivity or reflectivity, or the grating transforms incident light into a transmitted or reflected beam having a predetermined laterally varying polarization state.

The claims before the Examiner also are directed towards methods of imposing a desired intensity modulation on laterally uniform incident polarized light and towards methods of imposing a polarization state having a predetermined,

laterally varying azimuthal angle ψ on incident light. To impose the desired modulation, a laterally varying grating vector direction that provides the desired modulation is selected and the corresponding grating vector that has zero curl is found. To impose the polarization state, a grating vector with zero curl is found subject to the constraint that $\beta=\psi-\Delta\psi(K_0)$, where K_0 is the magnitude of the grating vector, β is the direction of the grating vector and $\Delta\psi$ is the difference between the azimuthal angle and the direction of the grating vector. A grating having that grating vector is fabricated and the incident light is directed at the grating.

§ 102(b) Rejections – Moshrefzadeh et al. '528

The Examiner has rejected claims 1 and 7-9 under § 102(b) as being anticipated by Moshrefzadeh et al., US Patent No. 6,391,528 (henceforth, "Moshrefzadeh et al. '528"). The Examiner's rejection is respectfully traversed.

As discussed below, independent claim 1 has been rendered allowable by the inclusion therein of the limitations of claim 4. It follows that claims 7-9, that depend therefrom, also are allowable.

§ 103(a) Rejections – Moshrefzadeh et al. '528

The Examiner has rejected claims 2-6, 10-29, 33-36, 38-40, 51-60, 64 and 65 under § 103(a) as being unpatentable over Moshrefzadeh et al. '528. The Examiner's rejection is respectfully traversed.

Moshrefzadeh et al. '528 teach a method of fabricating a wire grid optical element. Two or more coherent beams of light are directed at a substrate so as to form an interference pattern. High intensity regions of the interference pattern heat the substrate, allowing the deposition of a material such as a metal on the heated portion of the substrate. Alternatively, the interference pattern is formed by

diffracting one or more coherent beams of light and projecting the resulting fringes onto the substrate. Among the interference patterns with laterally varying grating vectors that are taught by Moshrefzadeh et al. '528 are a chirped interference pattern (column 7 line 18) and curved interference fringes (column 7 line22).

Presumably, the grating of the wire grid optical element produced using one of these interference patterns also would have a space-variant, continuous grating vector. Nevertheless, there are aspects of the present invention that are neither taught nor hinted nor suggested by Moshrefzadeh et al. '528. These include a periodic grating vector (claims 4 and 54), a grating that passes or reflects laterally uniform polarized incident light with a predetermined laterally varying transmissivity or reflectivity (claims 10, 12, 57 and 58) and a grating that transforms incident light into a transmitted or reflected beam having a predetermined laterally varying polarization state (claims 14, 22, 59 and 60).

A grating with a periodic grating vector is not obvious from Moshrefzadeh et al. '528 because the only interference patterns with laterally varying grating vectors that are taught by Moshrefzadeh et al. '528 are a chirped interference pattern formed using cylindrical lenses and curved interference fringes formed using spherical lenses. Neither method of forming an interference pattern produces an interference pattern that has a periodic, laterally varying grating vector. One ordinarily skilled in the art would not learn from Moshrefzadeh et al. '528 how to produce an interference pattern that is has a periodic, laterally varying grating vector.

A grating that passes or reflects laterally uniform polarized incident light with a predetermined laterally varying transmissivity or reflectivity is not obvious from Moshrefzadeh et al. '528 because Moshrefzadeh et al. '528 are totally silent on the subject of designing an interference pattern or grating, with a laterally varying grating

vector, to achieve a desired result. Similarly, a grating that transforms incident light into a transmitted or reflected beam having a predetermined laterally varying polarization state is not obvious from Moshrefzadeh et al. '528 because Moshrefzadeh et al. '528 are totally silent on the subject of designing a an interference pattern or grating, with a laterally varying grating vector, to achieve a desired result. Contrary to the Examiner's characterization of this subject as "routine experimentation", it is not at all obvious, *a priori*, what grating with a space-variant, continuous grating vector would transform laterally uniform polarized light into transmitted or reflected light with a predetermined laterally varying intensity, nor is it obvious, *a priori*, what grating with a space-variant, continuous grating vector would transform incident light into a transmitted or reflected beam having a predetermined laterally varying polarization state. If such gratings were obvious, then the prior art workers cited in the Field and Background section of the above-identified patent application would have used them instead of using stepwise continuous gratings because, as noted on page 2 lines 12-13,

> Discontinuities in the lateral variation of the transmission axis of a polarizer can produce diffractions which degrade the optical efficiency of the polarizer.

Even if such gratings were obvious, it still would not be obvious from Moshrefzadeh et al. '528 how to produce the corresponding interference patterns. The only specific (as opposed to generic) interference pattern with a laterally varying grating vector that is taught by Moshrefzadeh et al. '528 is the chirping interference pattern of column 7 line 18. The effect of a corresponding grating on laterally uniform polarized light, with regard to the lateral variation of the intensity of the transmitted light, is illustrated in Figure 2 of the above-identified patent application. The effect of a corresponding grating on incident light, with regard to the lateral

variation of the polarization state of the transmitted light, is illustrated in Figures 7A and 7B of the above-identified patent application. In both cases, it is the geometry of the grating that determines the nature of the transmitted light, and not the desired characteristics of the transmitted light that determines the geometry of the grating. To give the transmitted light a predetermined desired characteristic, for example intensity (as in Figures 6A and 6B), ellipticity (as in Figures 9A and 9B) or azimuthal angle (as in Figures 9C, 9D and 10) that varies linearly in the direction transverse to the direction of light propagation, requires a grating such as that illustrated in Figures 3 and 4. It is not at all obvious from Moshrefzadeh et al. '528 how to produce an interference pattern corresponding to the grating illustrated in Figures 3 and 4.

While continuing to traverse the Examiner's rejections, Applicant, in order to expedite the prosecution, has chosen to amend the claims so that these aspects of the present invention are recited in independent claims. Claim 1 has been amended to include the limitations of claim 4. New claims 67-70 are claim 1 amended to include the limitations of claims 10, 12, 14 and 22, respectively. Claim 51 has been amended to include the limitations of claim 54. New claims 72-75 are claim 51 amended to include the limitations of claims 57-60, respectively. Support for these amendments is found in claims 1, 10, 12, 14, 22, 51 and 57-60 as filed. (Note that the dependence of claim 60 as filed on claim 1 is an inadvertent typographic error. Claim 60 as filed should have depended from claim 51.) Correspondingly, claims 4, 10, 12, 14, 22, 54 and 57-60 have been canceled, claim 11 has been amended to depend from claim 67, claim 13 has been amended to depend from claim 68, claims 15, 16 and 19 have been amended to depend from claim 69, and claims 23, 24 and 27 have been amended to depend from claim 70.

Turning now to independent claims 33, 36, 64 and 65, these claims have been amended to emphasize that the modulation recited in claims 33 and 64 and the azimuthal angle recited in claims 36 and 65 are not merely the results of using an arbitrarily selected grating, but predetermined criteria for designing the grating. As noted above, it is not obvious from the prior art cited by the Examiner how to design and fabricate a grating with a continuous, laterally varying grating vector that gives the grating predetermined, *a priori* desired properties.

Specifically, the preambles of claims 33 and 64 have been amended to recite a method of imposing a desired modulation on the intensity of laterally uniform polarized light, and step (a) of these claims has been split into two steps, with the first step being selecting a laterally varying grating vector direction that defines the desired modulation. Support for these amendments is found in the specification on page 16 lines 3-8:

> The results of Figure 2 now will be applied to the design of a space-variant polarizer, specifically, a grating with a transmission axis that varies linearly along the x-direction and that is described by the grating vector
>
> $$\vec{K}(x,y) = K_0(x,y)\cos(ax)\hat{x} + K_0(x,y)\sin(ax)\hat{y} \qquad (3)$$
>
> where $\hat{x}$ is a unit vector in the $+x$-direction, as before, and $\hat{y}$ is a unit vector in the +y direction.

The laterally varying direction of the corresponding grating vector is arctan(ax).

Similarly, claims 36 and 65 have been amended to emphasize that the grating vector is selected so as to define the desired laterally varying azimuthal angle. Support for this amendment is found in the specification on page 20 lines 1-4:

> Equation (10) now will be used to design a grating for transforming circularly polarized light into a beam with an azimuthal angle that varies linearly in the x-direction. For such an operator, the local grating direction should be
>
> $$\beta(x,y) = ax - \Delta\psi(K_0(x,y)) \qquad (11)$$

With independent claims 1, 36, 51 and 67-70 allowable in their present form, it follows that claims 2, 3, 5, 6, 11, 13, 15-21, 23-29, 38-40, 52, 53, 55 and 56, that depend therefrom, also are allowable.

Objections

The Examiner has objected to claims 31, 37 and 62 as being based on rejected base claims. The Examiner has noted that claims 31, 37 and 62 would be allowable if rewritten in independent form including all the limitations of the base claim and any intervening claim.

Claim 31 has been rewritten in independent form by explicitly reciting the device of claim 1 as filed. Claim 62 has been rewritten in independent form by explicitly reciting the device of claim 51 as filed. Claim 37 has been rewritten in independent form as new claim 71.

Just as the Examiner has determined that claim 36 as filed would be allowable if it included the limitations of claim 37, so claim 65 as filed would be allowable if it included similar limitations. Therefore, new claim 76 has been added. New claim 76 is claim 65 as filed with the limitations of claim 37.

Other Amendments to the Claims

Claim 39 as filed should have depended from claim 36, not from claim 38. This inadvertent typographical error now has been corrected.

"Said" grating, as recited in steps (b) of claims 64 and 65 as filed, lacked antecedent basis. This inadvertent typographical error, a result of cutting and pasting claims 33 and 36 during the drafting of the claims, now has been corrected: step (c) of claim 64 as amended and step (b) of claim 65 now recite "a" grating. Similarly, step (b) of new claim 76 recites "a" grating.

Amendments to the Specification

Inadvertent typographical errors in the paragraphs beginning on page 24 line 19 and page 27 line 3 have been corrected. No new matter has been added.

In view of the above amendments and remarks it is respectfully submitted that independent claims 1, 31, 33, 36, 51, 62, 64, 65 and 67-76, and hence dependent claims 2, 3, 5-9, 11, 13, 15-21, 23-29, 34, 35, 37-40, 52, 53, 55 and 56 are in condition for allowance. Prompt notice of allowance is respectfully and earnestly solicited.

Respectfully submitted,

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Date: December 5, 2004